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ABSTRACT

This report surveys the various applications of information technology to research in the humanities and examines challenges that need to be overcome. The document is divided into five sections. The first section provides a background on changes brought on by technology in the humanities. The second section focuses on information technology and scholarship. Topics include: electronic communication; text; data; images; sound; combined sources/multimedia/World Wide Web; retroconversion projects; original and creative works; electronic publication; and tools. A summary of computer applications in humanities research and future outlook are included at the end of this section. New developments and change are discusses in the third section. The fourth section outlines institutional changes that are necessary to enable effective technology use in humanities scholarship. Topics include: training and support; project management; research infrastructure; digital libraries and archives; information resources; regulatory issues; preservation and access; funding; and humanities support services. The fifth section makes recommendations and lists priorities for humanists, technical experts, librarians, and administrators. Appendices in the final section include acknowledgments, bibliographies, and abbreviations and acronyms. (Contains 37 references.) (AEF)

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Information Technology in Humanities Scholarship:
Achievements, Prospects, and Challenges

The United States Focus

Pamela Pavliscak
Seamus Ross
Charles Henry

American Council of Learned Societies

ACLS OCCASIONAL PAPER No. 37
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Information Technology in Humanities Scholarship:
Achievements, Prospects, and Challenges

The United States Focus

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This report owes much to the work of the Humanities Information Review Panel sponsored by the British Library Research and Development Department and the British Academy under the Chairmanship of Professor J. T. Coppock, CBE, FBA, and to its report by Mary Feeney (The Data Workshop, Bury St. Edmunds) and Seamus Ross. As its title implies, this version focuses mainly on projects and issues in the United States. Some references to U.K. projects listed in the original booklet have been retained though, for the most part, current activity in the U.K. can be obtained from the bibliography of projects and services.

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Preface

This report surveys the various applications of information technology to research in the humanities. In the course of our investigations we came across a variety of innovative research that could have a profound impact on the humanities. However, the incidence of such work is uneven, and the widespread adoption of information technology in the humanities is being hindered by a number of significant obstacles. We also examine the challenges that must be overcome if such applications are to become the norm among scholars.

We present only a selective view of current activities, focusing primarily on work by American scholars, with some references to international projects of relevance to the humanities, since computer technology now makes scholarship a genuinely global enterprise. This overview is intended for scholars in the humanities who are not yet aware of what has been accomplished, as well as for those who direct and fund research and higher education. Their cooperation and understanding are needed for these obstacles to be overcome and for the potential of information technology in humanities scholarship to be realized.

In late 1997 a revised version of this publication will be made available on the World Wide Web, with links to the relevant projects and services. The electronic version will be maintained and expanded as part of the American Arts and Letters Network (AALN).

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I. Background

Computerized tools and digital resources are increasingly used in the creation, collection, storage, and dissemination of scholarly information. This phenomenon is having a pronounced effect on patterns of information use and communication. Significant improvements in technology—faster processors, large capacity storage devices, higher resolution screens, improved networks, more powerful and flexible software—have allowed humanists to use computers more effectively in their work. The speed and scope of such developments make it imperative that institutions and information professions serving the humanities become aware of the changing needs of their clientele. Libraries, museums, archives, publishers, information providers, and computer services all have a role to play.

A variety of organizations, including the American Council of Learned Societies (ACLS), the Getty Information Institute (GII), the Modern Language Association (MLA), the Coalition for Networked Information (CNI), national endowments, federal commissions, and a cross-section of scholarly societies, have met to examine the generation, storage and use of information in the humanities, and to look especially at new methods of manipulating information provided by the use of computers and associated technologies. Their aim has been to help information providers reassess and improve their services. They all emphasize the need for adequate funding not only for providers but also for the community of users, who must be equipped, motivated, and trained to take advantage of the opportunities offered by information technology.

These deliberations have taken place during a period of major structural change in the funding of higher education: a general background of declining resources, along with increasing pressure on the funds available for the maintenance and development of the collections, archives, and artifacts which are the principal resources for scholarly research in the humanities.

Humanists are becoming increasingly aware of the need to change information and communication practices as a positive reaction to the potential of technology. As more scholars learn about the benefits computers bring to the work of their colleagues, the demand for equipment, training, and support will grow. The financial pressures on higher education and on repositories of books, artifacts, and manuscripts also make change essential. This situation presents an opportunity for humanities scholars, information providers, and funders of research to take a positive role in the creation of improved and more widely available resources.

The following sections outline the impact of new technology on scholarship. They may give the impression of a high level of activity, but in reality the projects we describe are undertaken by only a small percentage of humanists. Many difficulties still confront scholars: problems of access to resources; shortage of equipment, skills, and support; difficulties of networking; and the challenges of converting materials into electronic form. All these areas require greater funding and coordination in order to bring about an overall improvement in humanities scholarship.

Other challenges to a more productive use of technology in the humanistic disciplines include the general insularity of the humanities community vis-à-vis technological advances in other disciplines; the reluctance of institutions to recognize computer-based work in the granting of tenure; the tendency to employ computers for projects in stylistics and word counts rather than in ways that might engage current theoretical approaches; the opaque jargon in which computer applications are

often clothed; the significant costs of equipment and software development; and the tendency of humanities projects to rely on individuals rather than institutions, and thus become vulnerable to a person's departure or change of status.

Within the humanities disciplines the overall picture is not one of widespread use of new technology, but rather a landscape with high levels of activity in some areas and low levels in others. Some of these difficulties are detailed in Section IV. Section V suggests follow-up activities which might have a global impact on humanities scholarship.

II. Information Technology and Scholarship

Introduction

Humanists have used computers since the 1950s, but until the 1980s usage could be described as occasional. Initially computers were perceived as number-crunchers, and most data were numerically coded for input and analysis. These data were often subject to purely statistical analysis, and eventually the "quantitative paradigm" took hold in some humanities disciplines, such as history and archaeology. The gradual realization that computer hardware and software could manipulate symbolic as well as numeric data had a remarkable impact on the kinds of projects for which computers were used. Today, most scholars recognize that data need not be numeric to find a place in humanities information processing.

To some extent the discussion of computer-based projects is best viewed from the vantage of the raw materials of scholarship, which include text, data, images, and sound. At least two additional resources must be considered: electronic communications, which permit the transmission of information; and combined sources (hypermedia/multimedia), which provide a platform for working with several different types of raw material simultaneously. The distinction between text and data, too, is somewhat artificial. Historians and archaeologists often work with kinds of information that are most effectively collected, manipulated, stored, and output in structured form. Some of the new tools for working with textual data have blurred the distinction between text and data, but many different types of information are still better handled as discrete units by statistical and database management software. To assess the impact of new technology on humanities scholarship, we concluded that it would be helpful if the developments were viewed in terms of the type of information involved.

If the use of computers for word processing, electronic mail, and simple searching of online databases or catalogs is excluded, the computer-based work done by humanists can be divided into five categories: the provision of general resources, such as library catalogs, dictionaries, and bibliographies; the retrospective conversion of manuscript or printed sources into machine-readable form; the creation of specific research tools, such as databases and image banks; the extraction of summary data from larger electronic resources, such as population censuses and tithe surveys; and the computer-assisted investigation of hypotheses and testing of models. The first three categories provide the basic resources for further research in the humanities and lay the foundation for the last two categories.

The use of computers to investigate hypotheses that must be tested with large and complex datasets has led to advances in archaeology, history, literary studies, and philosophy. Sir Anthony Kenny's study of the Aristotelian *Ethics*, which demonstrated that books ascribed to both the *Nicomachean Ethics* and the *Eudemian Ethics* actually belonged to the latter text and not the former, would have been difficult, and perhaps impossible, if carried out by manual investigation. Computers have allowed humanists to extend the agenda of inquiry. While computer applications assist in establishing the identities and relationships of primary sources, computerized texts and databases are also vital in rethinking the history of ideas and particular works. Keith Baker traced the evolution of *opinion publique* in the French Enlightenment using the American and French Research on the

Treasury of the French Language (ARTFL) text collection: he developed a tentative chronology of the use of the term in eighteenth-century France and showed how the traditional associations of opinion with uncertainty, instability, and disorder gave way to the rational authority of *opinion publique* in the late eighteenth century.

The projects described in this report illustrate the overall impact of new technology on scholarship. The coverage is not comprehensive; the projects cited are offered as significant examples of what has already been accomplished and what already is underway or planned for the future. Inevitably there are gaps. The discussion of sound, for instance, touches on sound cognition by musicologists, but excludes research into the understanding of text by linguists and literary scholars. The computerization of materials in museums, libraries, and archives is also not treated exhaustively. Major institutions, such as the Library of Congress, the National Archives and Records Administration, and research universities, have computerization programs, but smaller institutions often lack the resources, equipment, and training necessary to undertake such programs. We discuss in the concluding section some ways to address problems facing these institutions. Surveys by Michelson and Rothenberg and by Gould, the European Science Foundation's survey edited by Genet and Zampoli, and the Humanities Information Review Panel report in the United Kingdom (Feeney and Ross) have charted some of this work.

Electronic Communication

Developments in communications technologies and facilities have had a significant impact on the way scholars use and exchange information. The Internet came to the forefront as a powerful communications system for the higher education community in the 1980s. Since then, its use has grown dramatically and has extended beyond electronic mail and day-to-day communication to the exchange of papers, the launch of collaborative ventures, and the provision of online access to resources. In this context it is important to emphasize that the use of electronic mail (e-mail) and online information services requires a personal computer or intelligent terminal on every scholar's desk. In humanities departments such provision is by no means assured. Improved access is essential to ensure that all scholars have access to the growing range of Internet services.

The use of e-mail has led to the formation of discussion lists and bulletin boards. Discussion lists allow users to exchange ideas with other scholars and to distribute information to groups in their field. Users can "post" information to electronic bulletin boards and log in to read what interests them.

HUMANIST, operated jointly by the Center for Electronic Texts in the Humanities at Rutgers University and Kings College London, is a forum for scholars working in humanities computing or interested in the applications of technology to the humanities. The list includes over 1,000 registered users, a rather small percentage of the scholarly community. INTERDIS, another general discussion group for the humanities, offers announcements, conference notes, and informational queries rather than discussion of issues.

Most scholars use bulletin boards and discussion groups specific to their field of study. Specialized discussion groups and bulletin boards tend to promote discussion rather than distribute announcements. H-NET is an extensive series of discussion lists in history, with a rich variety of subfields offered for specialists in those areas. PHILOS-L was created to distribute information about jobs, conferences, and the occasional query, but users report it often hosts lively scholarly debates. ARCH-L, run from

Texas A & M University, is both a discussion list for archaeologists and a distribution service for data and software.

Other discussion groups are interdisciplinary, seeking to reinvigorate scholarship in traditional fields through new modes of interaction. PHIL-LIT is a forum for queries, information sharing, and previews of articles and reviews. The group promotes the exchange of ideas, owing no allegiance to a particular school or style of criticism, and is open to anyone with a serious interest in philosophical interpretations of literature, literary investigations of classic works of philosophy, philosophy of language, and literary theory. PSYCHE-D aims to encourage discussion and the exchange of information on research in cognitive science, neuroscience, philosophy, and other related disciplines with the aim of understanding the nature, function, and underlying mechanisms of consciousness. Discussion lists and bulletin boards may also focus on the work of an individual author or theorist, thereby bringing together scholars in different disciplines. While DESCARTES-L draws its audience mainly from scholars in philosophy, other discussion lists centered on individual theorists, such as DELEUZE-GUATTARI, attract scholars from almost every field in the humanities. AUSTEN-L serves as a discussion group for scholars of English literature, history, and gender studies, but also provides valuable interaction between scholars and interested lay readers.

In addition to discussion lists and bulletin boards, Internet Relay Chat (IRC) groups and multiple-user spaces (MUDs or MOOs) afford simultaneous textual exchange. One of the earliest projects of this nature is PMC-MOO, which hosts a real-time virtual discussion of recent articles in the electronic journal *Postmodern Culture* and of general issues related to contemporary cultural theory. Recently, the VRoma Project garnered funding from NEH to enhance students' study of Roman culture. VRoma is a multi-user, networked environment built upon a spatial and cultural metaphor of ancient Rome; faculty and students can meet, interact, collaborate, hold classes, and access databases, texts, images, and teaching materials.

Discussion groups, bulletin boards, and IRC are not without limitations. Impermanence is one of the more intractable problems of the Internet, and services often migrate, wither, or disappear altogether. At times a small group or an individual will tend to monopolize a discussion, which undermines the dialogic aspect of networked communication. The anonymity associated with bulletin boards and discussion groups can give participants a license for mischief that face-to-face interaction might inhibit; on the other hand, anonymity can also lead to more honest and creative exchanges.

Networked information, however, consists of more than just discussion lists, bulletin boards, and Internet Relay Chat. The Internet provides immediate access to electronic archives, automated library catalogs, and numerous information services. The Library of Congress, government publications distributed by the General Printing Office (GPO), congressional reports, full-text books and journals, shareware, census data, other numerical databases, and projects designed specifically for the scholarly community (such as the Dartmouth Dante Project)—all are available to online academic researchers. Items once available only in print, such as the ISI Arts & Humanities Search database, are now accessible over the Internet. As more and more institutions have established a presence on the Internet, the number of information sources has expanded enormously, giving rise to the concept of the "virtual library."

Indeed, as the Internet gained in speed and richness of available resources, librarians, scholars, and information technology specialists began to create new applications of considerable significance

to humanities scholars. These included new publishing opportunities; the digitization of picture and slide collections and of sound archives; the scanning and delivery of high-quality facsimiles of manuscripts, archives, and rare books; and the production of multimedia courseware and interactive learning sessions.

These applications came into being sooner than most had expected with the appearance of the World Wide Web. The Web, as it is usually termed, allows for multimedia file transfer and access to millions of sites around the globe. A scholar can perform research on the Web using search engines such as AltaVista, Lycos, Infoseek, and Webcrawler. He or she can consult digital image collections from the Vatican or the Louvre, digital text archives at major universities, film reviews, online journals, bibliographies, information on scholarly societies, syllabi for thousands of academic courses, moving images, online catalogs, dissertations, and other works pertinent to the humanities.

Specialized Web search tools are rapidly developing. Argos, for example, is the first peer-reviewed, limited-area search engine (LASE) on the World Wide Web. It has been designed to cover ancient and medieval cultures. Quality is controlled by a system of hyperlinked Internet indices which are managed by an international group of scholars serving as associate editors of the project. Argos is managed by the University of Evansville.

TORGO, maintained by the Department of English at the University of California at Santa Barbara, is another search tool designed to facilitate and promote scholarly research on the Web. TORGO searches abstracts of online journals and papers which have been screened for quality and usefulness. Web-Cite, a commercial venture, also collects information from online journals and returns search results by electronic mail.

Guides to Internet resources in the humanities, usually created by scholars in a given field, are another effective means of locating Web resources. Voice of the Shuttle, maintained by Alan Liu at the University of California at Santa Barbara, is one of the most comprehensive and popular guides to humanities resources on the Internet in fields ranging from anthropology to women and gender studies.

Other Internet subject guides focus on a particular field. Literary Resources on the Net, a large collection of references to Internet sites in English and American literature, was one of the earliest specialized subject guides for the Internet and is maintained by Jack Lynch, a doctoral student at the University of Pennsylvania. REESWeb at the University of Pittsburgh is a comprehensive index of electronic resources on Central Asia and the former Soviet Union.

In truth, however, the Web is still a fairly raw technology. It points to resources in an elegant and even flashy way, but still suffers from considerable drawbacks which include missing, defective, or outdated links; difficulties in ascertaining the authority behind most Web sites; the misleading titles of many sites; the burgeoning incursion of commercial ventures onto the Web; the sheer amount of material available; and the lack of direct access to the texts and other resources in some databases. Because the Web is a highly accessible mass publishing environment, many academics have embraced this new medium. The concept of an arena for public discourse appeals to most scholars. However, on the level of day-to-day work, the openness of the Web has led to a saturation of communication space that at times seems to erase the possibility of coherent discourse.

The potential of networked-based presentation for humanities scholarship is immense, but, at present, open to question. The Web today is in fact a more passive, anonymous tool than originally envisioned by its creators, Swiss physicists who saw the Web as a means for intensive collaboration.

In order to transform the Web into a genuinely collaborative space as opposed to a "surfable," alternate world, a community of scholars must be formed to bring to bear upon the Web the evaluative standards and professional discernment that are employed in more traditional scholastic endeavors.

Text

Humanities instruction and scholarship generally endeavor to reinterpret and reevaluate our textual legacy in an evolving understanding of larger historical, social, and cultural contexts. Since work in the humanities has been largely text-based, electronic text projects are becoming increasingly important as academic resources. Electronic texts include scholarly editions, corpora of contemporary writings and transcriptions, reference works, and instructional hypertexts. The most prolific electronic text producers combine the expertise of scholars, librarians, and humanities computing consultants. Electronic texts from manuscripts and printed sources are now available in different formats and from a number of different venues. Some projects endeavor to provide comprehensive coverage while others focus on a particular corpus of texts. Some are combined with integrated software for analysis and can be accessed only by means of that software; others offer plain text files which can be processed by software chosen by individual scholars.

Generally speaking, though, the primary purpose of a text archive is to ensure that machine-readable texts remain available to the academic community. Because the texts come from so many different sources, they vary considerably in format, accuracy, and type of coding. Discussion is ongoing on establishing standards of text encoding so that these archives remain universally pertinent.

Major text archives include the Electronic Text Center at the University of Virginia; the Center for Electronic Texts in the Humanities, jointly sponsored by Rutgers and Princeton Universities; the Humanities Text Initiative at the University of Michigan, Ann Arbor; and ALEX: A Catalog of Electronic Texts on the Internet, supported by North Carolina State University. In the United Kingdom, the Oxford Text Archive was established in response to the growing number of electronic texts prepared by individual scholars, major research projects, and publishers.

Advances in computer storage and retrieval have made the construction and use of text corpora much easier, and this has in turn widened their usefulness for research. A corpus differs from an archive in that it consists of a collection of texts gathered according to particular principles for a specific purpose. Several of the largest electronic text projects support inquiry across several traditional fields, facilitating interdisciplinary work. One of the best known, the Thesaurus Linguae Graecae (TLG), hosted by the University of California at Irvine, provides in machine-readable form the work of 3,157 authors who wrote in Greek from the time of Homer to CE 600 with historiographical, lexicographical, and scholastic texts from the period between CE 600 and 1453. It has been claimed that the 57 million words in the corpus represent 99 percent of the surviving Greek literature. The TLG accommodates different approaches to textual analysis, and this has encouraged the production of a number of text-handling packages designed specifically for work with this corpus. The advantages of electronic corpora, first demonstrated among classical scholars, are now perceived by scholars in other disciplines. The Dictionary of Old English (DOE) project, compiled at the University of Toronto, has converted the whole corpus of Old English texts to machine-readable form and is now available on magnetic tape or for searching online via the Internet.

Another corpus of significant value is the American and French Research on the Treasury of the French Language (ARTFL), maintained at the University of Chicago and co-sponsored by the Centre National de la Reserche Scientifique (CNRS). The project, originally initiated by the French government for the creation of a new dictionary of the French language, developed a corpus totaling some 150 million words, representing a broad range of written French. In most cases standard scholarly editions were used in converting the text into machine-readable form, and the data contain page references to these authoritative editions. ARTFL makes accessible approximately 2,000 digitized texts from the medieval period to the twentieth century. They include literary works, political tracts, philosophical theses, and technical writings, and such genres as novels, verse, theater, journalism, essays, correspondence, and treatises.

The American Verse Project, of the Humanities Text Initiative, assembles an electronic archive of volumes of American poetry spanning the eighteenth to the twentieth centuries. The full text of each volume is converted into digital form and coded in Standard Generalized Markup Language (SGML) using the Text Encoding Initiative (TEI) Guidelines. The archives, available over the Internet, may be searched in a variety of ways. A second goal of the project is to provide a service to scholars by advancing their ability to use Web documents in their work. Currently, the Internet does not have well-established mechanisms for authors seeking to integrate complete texts, or parts of texts, into their scholarship. This project will allow someone writing about Dickinson, for example, to embed links in his or her electronic text pointing the reader to various poems, stanzas, or lines that are part of the project without having to replicate the material within his or her own document.

Smaller projects, focused in a particular subject area, are also flourishing. The Dartmouth Dante Project database combines computer technology with more than 600 years of commentary tradition on Dante Alighieri's major poem, the *Divina Commedia*. This gives scholars easier access to the full texts of important critical works, many of which are rare and difficult to obtain. Likewise, the Wesleyan Confucian Project produces electronic texts of Confucian and Confucian-inspired texts from the eleventh century (CE) to the present. The recent improvements in optical character recognition (OCR) technology and encoded non-Latin characters has made possible digitization projects for Chinese, Japanese, Arabic, Hebrew, and Russian works.

Linguistics is another area where electronic text corpora are being developed on a large scale. The results are proving invaluable not only in lexicography and the preparation of language reference works, but also in the development of speech recognition for computers, machine translation, computer-assisted language learning, and "intelligent" word processing software.

Because human language is so complex, computer programs for processing it must be fed enormous amounts of data—including speech, text, lexicons, and grammars—to be robust and effective. Shared resources permit replication of published results, support fair comparison of alternative algorithms or systems, and permit the research community to benefit from corrections and additions provided by individual users. The Linguistic Data Consortium (LDC) is an open consortium of universities, companies, and government research laboratories supported by grants from the Advanced Research Projects Agency (ARPA) and the National Science Foundation. It creates, collects, and distributes speech and text databases, lexicons, and other resources for research and development purposes. The University of Pennsylvania is the LDC's host institution. Its collections include texts, audio files of telephone speech, and audio and video files of broadcast data, using

such computer-based linguistic technologies as speech recognition and understanding, optical and pen-based character recognition, text retrieval and understanding, and machine translation.

Many archive and corpora projects derive from academically funded work, but it is an indication of the growth of this area that commercial publishers are now investing in electronic texts, assisting with online publication, and creating and distributing CD-ROM, diskette, or print versions of academic electronic text projects. The Brown University Women Writers Project is creating a textbase of pre-Victorian women's writing in English. This is a sizable body of material which has been largely inaccessible to scholars and students. Despite its considerable historical and literary interest, its lack of availability has seriously distorted our view of the role of women in Western literary and cultural history. This project explores the educational advantages of integrating students into a technology-intensive interdisciplinary research project. Graduate and undergraduate students learn the techniques of literary text encoding, scholarly editing, book production, and traditional and electronic publishing by working in close collaboration with humanities computing specialists and literary scholars. The textbase is used to support a variety of products in different formats, including publication of selected works through a 30-volume print series and eventual online publication with Oxford University Press.

Many other commercial publishers are exploring the possibilities of new media. Chadwyck-Healey Ltd. offers a number of machine-readable full-text databases on CD-ROM, including the Database of African-American Poetry, which contains over 2,500 poems written by African-American poets between 1760 and 1900; Goethes Werke, an electronic version of the Weimar Edition of Goethe's works, originally published between 1887 and 1919; and the *Corpus des œuvres de philosophie en langue française*, which collects major works of post-Renaissance French philosophy and is developed under the direction of Michel Serres of *l'Académie Française*. Recently Chadwyck-Healey has assembled its English and American literature databases for inclusion in an online service, Literature Online (LION). LION brings together nine of Chadwyck-Healey's full-text literary databases. Together these comprise more than 208,000 poems, 4,000 plays, 290 works of prose fiction, and 21 versions of the English Bible. This service combines texts, electronic journals, discussion groups, reference works, bibliographies, and catalogs in English and American literature; it also provides hypertext links to relevant resources. Also included will be electronic bookshops for new and antiquarian books and journal articles, and a printing service for instructors who require bound copies of texts they have found in the database.

Scholarly effort and commercial funding have also gone into the provision of reference works in electronic form. The recently completed Oxford English Dictionary (OED) Second Edition on CD-ROM, published by Oxford University Press, makes use of specially designed search and retrieval software. This electronic version of the 20-volume dictionary contains 60 million words and allows researchers to carry out sophisticated searches not feasible using only the print version. For example, the system supports both browsing and searching through quotations, definitions, and etymologies. Researchers interested in etymology can find all words derived from a particular language, such as that of the Blackfoot Indians. A search combining date, author, publication, or word will find specific quotations. The Stanford Encyclopedia of Philosophy, sponsored by the American Philosophical Association and the Philosophy Documentation Center at Bowling Green State University, represents a dynamic database of information on philosophers to which scholars from all over the world contribute.

Machine-readable text offers further possibilities which have been realized in the concept of hypertext. Hypertext has emerged as a way of exploring and manipulating text that is non-linear, non-numerical, and conducive to allowing readers to discover and create their own paths through material. It provides a means of linking texts in an associative way using "nodes" and "links," an electronic version of footnotes and cross-references. The links can be preserved to permit others to follow predefined paths or to define their own paths. This technique is particularly suited to reference works and collaborative writing.

The Victorian Web, for example, is the Web version of Brown University's Context 61, which serves as a resource for courses in Victorian literature. The materials originally derive from Context 32, a hypertext developed with Intermedia software that provided contextual information for English 32, a survey of English literature from 1700 to the present. The Victorian Web includes hyperlinked information about individual authors, Biblical typology, Romantic and Victorian timelines, feminism and literary theory, public health, race and class issues, and anti-Catholic sentiment in Victorian England. This collection of materials on nineteenth-century British culture continues to grow as students and faculty at Brown University and other institutions contribute new essays, questions, and images.

Electronic text can also be used together with text analysis software—whether integrated or separate—to carry out complex textual analysis, providing the researcher with both microscopic and macroscopic views of the text, from small-scale features of an individual work to searches across an entire corpus. These tools can be used to create critical editions, carry out stylistic comparisons or lexical analysis, and attribute authorship. An example is the examination by Gerard Ledger of the works of Plato. By taking the simplest possible feature of language—the occurrence of particular letters of the alphabet—and subjecting it to a complex multivariate analysis, Ledger was able to draw new conclusions about the authenticity of dubious dialogues and the chronology of the entire corpus.

Donald Foster recently received national attention for his work in establishing, with wide critical acceptance, the author of a little-known Renaissance elegy to be William Shakespeare. The hermeneutic facet of his research cannot be minimized, but the stylistic analysis performed by the computer was integral to his conclusions. Foster performed a frequency-of-use match of words in the elegy against the full corpus of Shakespeare's writings and other contemporary authors. From this analysis Foster could conclude that selected words and their contextual phrasing were unique to Shakespeare; enough of these appeared in this "lost" elegy to strongly suggest the Bard's authorship.

Computer-based textual analysis can also assist scholars in the production of critical editions. The Canterbury Tales Project, in which Sheffield and Oxford Universities collaborate, draws upon the traditional methods of textual criticism and new software to reveal unseen patterns in the multiple manuscripts of Chaucer's *Canterbury Tales*. The main objective of the project is to produce a library of resources which can assist in the creation of critical editions of the *Tales*, language studies, and historical and cultural analysis. The manuscript tradition for *The Canterbury Tales* includes some 83 manuscripts, some of which are fragmentary. Although the *Tales* are well understood, study of the entire manuscript tradition was not feasible before the advent of computer systems capable of handling significant quantities of data.

Data

The use of computers for handling data is well established in historical and archaeological research, which require the scholar to extract data from source material, formalize them, and organize them for analysis. In these areas the individual dataset, collected and organized for specific projects, is predominant. While some projects do rest on the analysis of textual information, structured data is the basic source for many studies. History projects have spearheaded the creation and dissemination of electronic datasets, though these datasets are becoming increasingly important to scholars working in cultural studies, linguistics, and gender studies.

One example is the Dumbarton Oaks Database Project, which assembles information on Byzantine culture and society drawn from Greek hagiographical texts. The database includes over 100,000 data entries. Additionally, text files of the vitae provide immediate access to the chapter of the text from which data has been extracted. The database is accompanied by brief introductions to each vita with summary biographical and chronological information.

Other computer datasets have emerged out of counterparts in print publications. Ethnologue, sponsored by the Summer Institute of Linguistics, is a catalog of the world's languages. The Summer Institute of Linguistics specializes in work with languages spoken by the world's lesser-known linguistic groups by developing programs in partnership with host governments, universities, churches, and local people to promote linguistic research, language development, literacy, translation, and other educational and research projects. The database includes information on number of speakers, location, dialects, linguistic affiliation, and other sociolinguistic and demographic issues. This database represents the twelfth edition of the print version of *Ethnologue*. The data may be browsed by country or language family, and includes interactive maps, a language distribution chart, and search capabilities.

Another category of very large online datasets is the combined library catalog. One of the largest in the world is the Online Consortium of Library Catalogs (OCLC), based in Dublin, Ohio, and containing over 32,000,000 bibliographic records. A rival project is the Research Libraries Information Network (RLIN), based in California, with over 77,000,000 records from over 250 sources describing books, journal articles, dissertations, and rare materials in over 365 languages. These undertakings are of fundamental importance to libraries around the world, with access by individual scholars increasingly a part of each organization's marketing strategy.

An important question for the providers of large datasets and archival material is how the database should be organized to optimize access for users. The automation of archive catalogs has led in some cases to a reconsideration of the way this material is designed and prepared. Berkeley Finding Aids for Archival Collections, funded by a grant from the Department of Research and Development and sponsored by the Commission on Preservation and Access, provides finding aids in a standard, platform-independent electronic form. Finding aids are inventories, registers, indices, or guides to collections held by archives, manuscript repositories, libraries, and museums. The Berkeley finding aids provide detailed descriptions of collections, their intellectual organization, and—at varying levels of analysis—of individual items in the collections. Access to the finding aid allows scholars to explore the content of a collection and determine whether it is likely to satisfy his or her research needs. The Berkeley project makes finding aids for a number of American archives available online.

The project is developing sophisticated searching and sorting capabilities so that information may be retrieved according to individual need.

Some specialized datasets are commercially available on optical storage media. One example is the CD-ROM version of the Eighteenth-Century Short Title Catalogue published by the British Library. Those who study eighteenth-century history, literature, and culture can identify the current location of printed material by particular authors or having particular titles from among the 305,000 records. They can also investigate where works were published and which printers handled particular categories of books.

The Trans-Atlantic Slave Trade Database Project, of the W.E.B. Du Bois Institute for Afro-American Research at Harvard University, aims to disseminate computerized data on most of the slave voyages that sailed from Africa to the Americas from the sixteenth century to the late nineteenth century. The project has gathered records from 75 percent of all the slave ships sailing under British, French, Spanish, and Dutch flags between 1662 and 1860. The data details mortality, age, sex, crew membership, conditions on slave ships, duration of voyages, nature of slave resistance, business organization of slave traders, and age and physical characteristics of vessels. When the project is completed, data will be published on CD-ROM by Cambridge University Press. The core set of more than 20,000 transatlantic slave voyages will constitute the largest data source for the long-distance movement of peoples before the twentieth century. Refined demographic data on the volume of the trade (and thus of pre-colonial African populations) and on the spatial distribution of African peoples in the Atlantic world will allow scholars to assess more accurately questions of African state formation, agricultural and ecological change, African cultural survivals, and the development of the Atlantic economies.

In historical research, scholars who use computers usually create their own datasets. A large number of machine-readable historical data files have been created over the years, not only by historians, but also by geographers, anthropologists, genealogists, family history groups, and sociologists. The Arts and Humanities Data Service (AHDS) was recently established in the United Kingdom by the Joint Information Systems Committee to facilitate the creation and use of electronic resources in the arts and humanities. To achieve this aim, the AHDS will collect, describe, catalog, preserve, and provide subject-specific user support for digital resources that are created as a product of scholarly research; facilitate collaboration between arts-based user communities and the commercial or non-profit sectors; and promote standards and guidelines for the creation, description, preservation, and scholarly use of electronic information.

Scholars engaged in historical research make use of an increasingly wide range of software packages in order to assemble, organize, analyze, and display their source material. Statistical packages, in use for many years, have been augmented by programs for relational database management, nominal record linkage, mapping, and hypermedia. Developments in software that allow data to be input in a way that preserves their complexity and irregularities facilitate source criticism, which is fundamental to historical study. The British Academy's Prosopography of the Byzantine Empire, developed and housed at King's College London, was established to create a database of all documented persons in the Byzantine Empire from CE 641-1260. The information includes names of the individuals, their responsibilities, first and last date mentioned, sex, career titles, topographical details, sources of the information, and a short article about each person. The inquiries made possible by the database have surprised even its creators; it is possible, for example,

to find all bishops whose brothers were also bishops, or the names of all individuals who appeared at the court of a particular emperor, along with information on religious sects, languages, and patrons.

Visualization of information has long been a valuable explanatory tool among historians and archaeologists. Computer mapping systems in general and geographical information systems in specific have increased the options for generating presentations of this kind. The Alexandria Project represents a consortium of researchers, developers, and educators, spanning the academic, public, and private sectors, who are exploring a variety of issues related to a digital library for geographically-referenced information. All of the objects in the library will be associated with one or more regions on the surface of the earth. The Alexandria Digital Library is an online information system that provides access over the World Wide Web to a subset of the holdings, as well as other geographic datasets. It is sponsored by the Map and Imagery Laboratory in the Davidson Library at the University of California, Santa Barbara

More recently, visualization techniques have also been applied to textual information. The Language Visualization and Multilayer Text Analysis Project, sponsored by the Cornell Theory Center, created a prototype tool for the study of language and discourse phenomena in three-dimensional space. The tool allows a researcher to conduct interactive research in the structures and typologies of discursive formation in large samples of textual data. Using this resource, scholars can develop new techniques for reading and interpreting text space.

Images

One promising facet of digital technology is that it makes visual, textual, and numeric information both more accessible and easier to handle. Archaeologists, art historians, geographers, and historians are making increasing use of digital image processing, image enhancement, and graphics. Current projects incorporate three-dimensional modeling, enhanced data identification, high-resolution scanning techniques, and online exhibitions of visual primary sources.

The rapidly-developing field of computer graphics is beginning to play a key role in archaeological data processing. Such systems bring to archaeology new mechanisms for analyzing data. Using graphical representations, archaeologists can explore a range of different configurations and interpretations of evidence, and thus take a "second look."

Computer modeling systems are also being used to build reconstructions of historical spaces. The Rossetti Room is a Virtual Reality Modeling Language (VRML) model of the studio of the pre-Raphaelite painter and poet Dante Gabriel Rossetti. Users can select one of a series of paintings to be placed in the room, which is then created from existing files by means of a simple program. The virtual room recreates the work environment of Rossetti. Each picture provides a link back to the two-dimensional HTML page in the archive. This project is a part of Jerome McGann's The Complete Writings and Pictures of Dante Gabriel Rossetti: A Hypermedia Research Archive at the University of Virginia's Institute for Advanced Technology in the Humanities. The archive is a structured database holding digitized images of Rossetti's works in their original documentary forms. Rossetti's poetical manuscripts, early printed texts—including proofs and first editions—drawings, and paintings are stored in the archive in full color. The materials are marked up for electronic search and analysis and supplied with full scholarly annotations and notes.

In addition to three-dimensional analysis and solid-modeling, images captured by digital cameras or by digitizing conventional photographs offer scholars new tools. Museums and art galleries have recognized digital technology as a way of providing enhanced access to their collections and have established a number of computerized systems as permanent or temporary displays. These applications and other educational packages incorporating digitized images have been designed with interactivity as a prime concern.

The Museum Educational Site Licensing (MESL) project is a collaboration of seven collecting institutions and seven universities that define the terms for the educational use of digitized museum images. MESL participants include the Fowler Museum of Cultural History; the George Eastman House; Harvard University Art Museums; the Library of Congress; the Museum of Fine Arts, Houston; the National Gallery of Art; the National Museum of American Art; American University; Columbia University; Cornell University; the University of Illinois at Urbana-Champaign; the University of Maryland at College Park; the University of Michigan; and the University of Virginia. This group develops a model educational site license, evaluates procedures for the collection and distribution of museums' digital images and information, and assesses the impact of this distribution in both technical and economic terms. At the end of this experiment, the participants will propose a broadly-based system that could support ongoing distribution and educational use of museum images and text.

Most major museums host online exhibitions—for example, the Smithsonian and the Whitney—but now smaller university museums are able to share images of their collections over the network. The Oriental Institute Museum showcases the history, art, and archaeology of the ancient Near East. An integral part of the University of Chicago's Oriental Institute, which supports research and archaeological excavation in the Near East, the Museum exhibits major collections of antiquities from Egypt, Mesopotamia, Iran, Syria, Palestine, and Anatolia. This museum uses a series of panoramic movies to guide visitors through a virtual tour of the galleries.

The techniques of image storage and analysis developed in scientific disciplines, including crystallography, astronomy, and medicine, clearly have potential for the humanities. The Image Understanding Environment (IUE), developed with the support of NASA, provides a rich set of tools for working with imaging data that opens new possibilities to humanists. Standards are currently under development for recording high-resolution digital images of works of art and encoding information about these images, whether through textual description or metadata in the image file itself. The Digital Image Access Project, sponsored by OCLC and the Coalition for Networked Information, is developing standards for image archiving, compression, representation, and description. The American Memory Project of the Library of Congress was one of the first sites to implement developing standards in digital image creation and transmission, offering background papers and technical information that describe the digital imaging process.

Images accompanied by textual data are often the only way to provide flexible and dynamic access to collections. SPIRO, the visual online public access catalog for the University of California at Berkeley's Architecture Slide Library, comprises approximately 200,000 35mm slides. SPIRO can be accessed using either Image Query, a powerful database retrieval package, or the World Wide Web. ImageQuery 2.0 was developed by Berkeley's Information Systems and Technology and the Museum Informatics Project; it permits research by 10 different fields: period, place, creator name, object name, view type, subject terms (from the Art and Architecture Thesaurus), source of image, creation dates, classification number, and image identification number. Digital surrogates of the

slides help users identify the exact image for which they are searching. SPIRO currently contains 16,000 records linked to images. The Web version of SPIRO supports research by five fields: period, place, creator name, object name, and subject terms.

Similarly, a.k.a., developed by the Getty Information Institute, is an experimental searching tool that uses the Institute's vocabularies to provide enhanced access to databases of cultural information. The service allows users to search through thousands of records from several Getty databases, including the Avery Index to Architectural Periodicals , the International Repertory of the Literature of Art (RILA), and the Provenance Index Databases. The a.k.a. uses the Art & Architecture Thesaurus (AAT) and the Union List of Artist Names (ULAN) vocabularies to enhance searches. The Clearinghouse of Image Databases at the University of Arizona, which includes the IMAGELIB listserv archives, is currently the most comprehensive listing of image projects in libraries and archives.

The digitized image, combined with computer technology, offers the art historian the same kind of opportunity for retrieval and manipulation as that enjoyed by the classicist working with the Thesaurus Linguae Graecae. Most access to images is still via textual description of the image, but this is not necessarily the most useful means of access. Even on modest computers, programs manipulating digitized descriptive codes derived from existing art reproductions can make accurate distinctions between images that appear similar to the human eye. But this is only one possible application of such a tool; a more useful function will be in the searching of archives of visual images to find similar and related compositions. This type of system offers possible applications in the areas of identifying, referencing, classifying, and analyzing images. As hardware with large storage devices, faster processors, and enhanced resolution and graphics capabilities becomes more widely available, art historians will have increased opportunities to perform research of this kind.

Sound

Digitized sound, not unlike images and data, can be created, manipulated, and analyzed by computer. Computers can generate or modify musical signals and serve as a control device for electronic musical instruments. Electronically-generated music, or electroacoustic music, revolves around the Musical Instrument Digital Interface (MIDI). Originally MIDI allowed electronic keyboards and associated sound processors to interact in the studio or on the concert platform. Since then it has emerged as a protocol for information exchange through the development of software which allows performers to record and edit performances and composers to build up complex pieces of music. Since MIDI files mainly contain information about sequences on peripheral devices, it is possible for sophisticated sequencing software to run on low-cost microcomputers. Composers thus have access to powerful tools to create, edit, mix, process, and filter sound and can record their compositions to disk.

Performance of electroacoustic music rarely involves computation taking place on stage, although projects based at the Massachusetts Institute of Technology (MIT) and the Institut de Recherche et Coordination Acoustique/Musique (IRCAM) in France are exploring this avenue with the aid of artificial intelligence (AI) techniques. The goal of the MIT project is to produce what may be called an automatic accompanying machine: in a live performance a human performer can respond to the computer's output, but the computer cannot reciprocate. For a computer to embody the

characteristics of a performing musician, it must be able to analyze sound into coherent and discrete pitches of determinate duration and spectrum (timbre), and then use that analysis of the acoustic signal as a basis for interpreting a musical signal. It must generate a plausible model of what the live performer is doing, and then use this information to structure its own performance. To build such a machine requires an understanding of the psychoacoustical and psychological processes involved in listening to and performing music. The MIT team has had to incorporate some "engineering," rather than cognitive, solutions in their system: this indicates the limitations of present understanding of the cognitive processes underlying musical perception and performance.

Advances in compression schemes for audio files have opened possibilities for the networked delivery of music performance. The Center for Research in Electronic Art Technology (CREATE) at the University of California at Santa Barbara supports online production of electroacoustic and computer music and electronic media art technology. The CREATE facility consists of multi-track digital recording and monitoring studios, a collection of multimedia workstations, and a network of stereo and quadraphonic digital synthesis studios. The main focus of its research is wide-area network-based media.

The ability to deliver sound files across a network enhances online scholarship in music theory, as well. The Journal of Seventeenth-Century Music provides a refereed forum for scholarly studies of the musical cultures of the seventeenth century. The areas of concern include historical and archival studies, performance practice, music theory, aesthetics, dance, and theater. The Journal emphasizes audio examples which are presented as monaural audio files and can be played on most systems with audio hardware and software. Likewise, Ethnomusicology Online features peer-reviewed articles; reviews of audio, video, and multimedia titles; and enhanced Ph.D. dissertations, all accompanied by illustrative audio files and multimedia.

Combined Sources: Multimedia/WWW

Hypermedia systems, also known as multimedia, use hypertext techniques to link other media—images, graphics, animation, sound, and video—to text. Information linked in this way becomes a flexible reference tool, effectively functioning as an automated encyclopedia, but with the advantage of giving visual proximity to conceptual connections. Hypermedia systems are interactive, allowing users to find their own path through the material; they have obvious potential for both research and learning.

One of the best established hypermedia products is Perseus, a multimedia database designed to aid the study of archaic and classical Greece. Perseus expands the ways in which ancient Greek literature, history, art, and archaeology can be investigated. In addition to complete literary texts, Perseus contains a lexicon, morphological databases, an extensive archaeological catalog with accompanying illustrations, several atlases, site plans, an illustrated catalog of Greek vases, a classical encyclopedia, and an historical overview of the history of the classical period. Like many projects (including the American Verse Project, the Early American Fiction Archive, and the Dante Gabriel Rosetti Archive), Perseus is available in two versions: a large collection on CD-ROM and a smaller subset of resources available without charge on the Web.

Another important multimedia project is American Memory: Historical Collections for the National Digital Library, undertaken by the Library of Congress. American Memory consists of primary source and archival materials relating to American culture and history, combining film (early moving images of New York City); photographs (from the Office of War Information and the Civil War); sound recordings (World War II newsreels); and manuscripts (the WPA Federal Writers' Project during the 1930s). The project encompasses more than 210,000 images from over 20 of the Library's collections. Similarly, the Valley of the Shadow: Two Communities in the American Civil War, a project sponsored by the Institute for Advanced Technology in the Humanities and the National Endowment for the Humanities, draws on resources ranging from government documents, newspapers, photographs, personal papers, maps, rosters, and government documents. The collection examines the communities, daily life, politics, and religious and racial conflicts surrounding the Civil War. The collection also traces the course of events from impending crisis to the secession and is projected to continue through the war and into the postbellum era.

Hypermedia projects have the potential to become powerful teaching tools. The Labyrinth, created at Georgetown University, provides organized access to electronic resources in medieval studies, including an electronic library of texts and images, online forums, professional directories and news, online bibliographies, an online "university" of teachers and scholars available for electronic conferencing, and an archive of pedagogical tools. This project will not only provide an organizational structure for electronic resources in medieval studies, but will also serve as a model for similar, collaborative projects in other fields of study.

The Electronic Beowulf Project takes advantage of advanced imaging technology to assemble a database of digital images of the Beowulf manuscript and related texts. The archive already includes fiber-optic readings of hidden letters and ultraviolet readings of erased text in the early eleventh-century manuscript; full electronic facsimiles of the indispensable eighteenth-century transcripts of the manuscript; and selections from important nineteenth-century collations, editions, and translations. Future additions will include images of contemporary manuscript illuminations and material culture, and links with the Toronto Dictionary of Old English project and with the comprehensive Anglo-Saxon bibliographies of the Old English Newsletter.

Retroconversion Projects

Libraries, in cooperation with scholars, are engaging in a number of large-scale retroconversion projects to enhance access to rare texts or other materials that are brittle, damaged, or not easily accessible. Preserving unique and rare materials has been a principle function of research libraries but a costly part of their mission. Security concerns also require that physical access to rare books be restricted. The Internet offers the possibility of greatly expanded access to rare and delicate materials. And while computer images of rare book pages can serve only as pointers to the original artifacts, the combination of searchable text and high-resolution color images provides a detailed and flexible view of the material to teacher and scholar alike.

The Victorian Women Writers Project at Indiana University produces highly accurate transcriptions of rare, often unpublished, literary works by British women writers of the late nineteenth century.

encoded using SGML. The works include anthologies, novels, political pamphlets, and volumes of poetry and verse drama along with bibliographical descriptions. While the Victorian Women Writers Project focuses on converting the text, the Making of America Project (MOA) creates high-quality digital page images of important materials on the history of the United States. The Cornell University and University of Michigan libraries are cooperating in the initial phase of MOA by selecting complementary journals and monographs to ensure full capture of all significant information. The University of Virginia Library's Early American Fiction Project will provide both text files and page images of 582 volumes of early American fiction. The project also presents the opportunity to study scholarly use of rare books and their computer simulacra, and to determine the extent to which electronic texts of rare books can serve scholars.

While many retroconversion projects focus on books, others incorporate collections of historical data. The University of Michigan Papyrus Collection spans a broad range of materials: textbooks, lectures, private notes and accounts, letters, invitations, decrees of kings and emperors, official petitions, contracts and agreements of every kind, purchase orders, checks, medical recipes and prescriptions, receipts, tax lists and declarations, court proceedings, and other legal texts. The documents exist on papyrus fragments currently preserved in glass casings; the most important are being digitized at high resolution for archival purposes and at lower resolution for the Web.

JSTOR, originally a project of the Andrew W. Mellon Foundation, is an independent organization that is building a comprehensive archive of scholarly journals. The project has important potential cost savings for libraries, and will be closely studied for its impact on the scholarly research process in the humanities and other disciplines.

Microfilm, long used as a means of preserving brittle books, is also under consideration for digitization. Yale University Library's Project Open Book, supported by the Commission on Preservation and Access and the National Endowment for the Humanities, is a research and development program that is exploring the feasibility and costs of large-scale conversion of preserved material from microfilm to digital imagery. Project Open Book aims to create a 10,000-volume digital image library and to enhance access to the converted volumes through the creation of document structure and page number indices. Furthermore, the project will provide greatly enhanced access to these materials over the Internet.

Archival holdings are the focus of some retroconversion projects. The Center for Electronic Texts in the Humanities sponsors several pilot projects, among them an experiment in encoding archival materials in order to link the finding aid with the full text of documents. The William Elliot Griffis Collection Project, part of Rutgers University Special Collections, is a major grouping of nineteenth- and early twentieth-century print, manuscript, photographic, and ephemeral materials relating to the early history of Japan-U.S. relations. This pilot project demonstrates the feasibility of a networked electronic access tool for collections of rare documents, according to the guidelines of the TEI (Text Encoding Initiative) and of the EAD (Encoded Archival Description). The finding aid is used as a "frame" within which some of the rare manuscript materials held in the collection may be accessed. Listings in the finding aid are provided with hypertext links to electronic editions of the manuscripts, two views which in turn provide the essays and images in the manuscript pages.

Archives of photographs and slides form the basis of one of the largest retroconversion projects. The Research Libraries Group's Digital Image Access Project (DIAP) involved nine academic institutions in partnership with Stokes Imaging of Austin, Texas. This consortium experimented with

an online image management system to find economical ways to catalog and index large photographic collections. Approximately 9,000 images related to the theme "The Urban Landscape" were digitized and included in the project database along with related index records. Collections include many images from the Avery Library at Columbia University, images of the Bronx, construction photographs of the Empire State Building, and architectural drawings from the Aviador Collection.

Original and Creative Works

A growing number of writers, artists, and scholars are turning to the Internet and the Web for creative expression and using hypertext and hypermedia as methods of publishing original works. Michael Joyce's hypertext novel *Afternoon* was among the first to engage the reader specifically through hypertext, where the software was integral to the experience and interpretation of the novel. A number of writers, sometimes referred to as the "Eastgate School" after the name of the prominent hypertext publisher, are creating hypertext fictions. Other recent works in this genre include Stuart Moulthrop's *Victory Garden* and Jane Yellowlees Douglas' *Patchwork Girl*.

The Electronic Poetry Center of the State University of New York at Buffalo serves as a central gateway to electronic resources in poetry and poetics. A collaborative effort of the University Libraries, the Faculty of Arts and Letters, and the Poetics Program, the Center represents one of the first electronic publishing projects joining the academic and creative communities. The Center makes a wide range of contemporary experimental and innovative poetry available online. Resources include collections of texts, a directory of contemporary poets, small press announcements, poetry events, spoken word archives, electronic journals, and gallery areas. The Center also sponsors online collaborative writing spaces. Selected online texts are cataloged and made available nationally and internationally through major bibliographic databases.

Today many poetry journals, including *RIFT* and the *Mississippi Review*, are published online using hypertext links, audio archives, and accompanying images. In the classroom, students contribute to hypertext novels, diaries, and journals that form new kinds of participatory original works (Slatin). This virtual colloquium engages students in ways that differ substantively from traditional concepts of classroom, course assignments, and the iterative accumulation of knowledge.

Educators recognized the value of hypertext and multimedia for pedagogic purposes during the 1980s. This gave rise to such earlier projects as the focus on Shakespeare at Stanford, the emblem book at the Memorial University of Newfoundland, and the project for Robert Browning at Cornell. Perseus, mentioned earlier, also began at this time and has evolved with the technology in compelling ways. Hypertext and multimedia allow for deeply nested fields of associations; a line in Browning's "Caliban Upon Setebos" can be connected to other works of Browning and Shakespeare, to various contemporary treatises on art, and to images of related plastic arts. The sound of someone reading the lines and moving images can also be called up to help contextualize the poem. Critics of this approach feel that while the variety and breadth of allusions can create an effective teaching tool, the secondary material is necessarily limited to a particular perspective while possibly giving the student the illusion of thoroughness. The Brown Storyspace Cluster, a collection of several hundred hypertext and hypermedia Webs, gathers informational materials, fiction, and poetry

created by Brown faculty members, including Robert Arellano, Robert Coover, George Landow, Massimo Riva, and students in their courses between 1992 and the present.

As poets, novelists, and scholars continue to work in hypertext and networked publications, future critics and readers will need to become increasingly familiar with this technology. Primary networked sources will thus pressure the academy to undertake new kinds of training in order to access the new sources of creative expression.

Electronic Publication

Several years ago Stephen Harnad, then at Princeton, founded a ground-breaking journal called *Psycholoquy*, designed to be a peer-reviewed journal of the highest caliber but available only online. The reasons for this were widely broadcast by Harnad: journals in his field were terribly expensive; the field in question, cognitive neuroscience, was of interest to very few researchers worldwide; review of submitted articles could take months, with this delay often dating the article by the time of publication; printed journals were difficult to come by in schools without large budgets; and the nature of printed journals required that they accumulate in discrete volumes, rendering difficult a more dialogic interaction of scholars with the ideas presented in their pages.

Psycholoquy has been a reasonably successful venture. The turnaround time for editorial review of submitted articles is six weeks; the scholars vetting submission are distinguished in their fields; the subscription is free to anyone with an Internet connection; the articles are indexed, and scholars can respond to individual articles with their responses attached to the original article to stimulate additional responses. Scholarly electronic publishing continues to show strong growth, with faculty collaborating to disseminate new research online (Bailey).

Many electronic journals are published by individual scholars or by scholarly societies rather than by academic publishers. Some journals, like *Critical Inquiry*, an interdisciplinary journal for the arts and humanities, publish only tables of contents and excerpts of current and back issues. Others focus on one aspect of the traditional scholarly journal: *History Reviews On-Line* is a quarterly electronic journal devoted to reviewing books on all fields of history. The International Philosophical Preprint Exchange is a service provided by the Department of Philosophy, Chiba University, and an international working group comprised of scholars at the University of Toronto, York University, the University of Missouri, and the University of Alberta. The Exchange provides preprints of articles and voluntary peer review, as well as information on eventual publication or presentations at conferences.

More and more journals are offering the complete text of articles online. The *Slavic Review* publishes an electronic post-print edition of the print journal, with articles appearing on its Web site several months after print publication. *Bryn Mawr Classical Review*, founded by James O'Donnell at the University of Pennsylvania and designed for publication on the Internet, publishes the complete text of articles. *Early Modern Literary Studies*, a refereed journal for English literature, literary culture, and language during the sixteenth and seventeenth centuries, features complete articles as well as an online readers' forum and links to related Internet resources in the field. The *Journal of Buddhist Ethics* is also designed specifically for online publication; in addition to publishing peer-reviewed scholarship, it hosts online conferences and offers the full text of the Pali Canon online to which scholars may link in their articles.

As of this writing, the number of electronic journals exceeds 1,700 and is increasing at a rapid pace each year. Many, like *Psycholoquy* and *History Reviews*, are new entries in reaction to the slow and costly printed serial publications. Publishers of traditional journals have been slow to warm to the idea of electronic publishing because of the uncertainty of revenue and also because the medium is new, with a predisposition for transience: machine and software obsolescence, uncertainty of funding, and the uncertain status of electronic publishing as legitimate work for tenure consideration all contribute to their doubts.

Nonetheless, academic presses are beginning to offer full-text journals online for a subscription fee, and it is likely that the future of serial publication will be predominantly a networked enterprise. Project Muse provides worldwide, networked, subscription access to the full text of over 40 Johns Hopkins University Press scholarly journals in the humanities, social sciences, and mathematics. JSTOR proposes to build a reliable and comprehensive archive of important scholarly journal literature, improve access to these journals, fill gaps in library collections of journal back issues, address preservation issues such as mutilated pages and long-term deterioration of paper copy, and assist scholarly associations and publishers in making the transition to electronic modes of publication.

Tools

A remarkable amount of commercial software is currently available. Tools for handling text, data, and images can often be tailored to support a range of humanities research projects. BRS Search and similar programs offer powerful free-text search capabilities; they are proving useful in many areas, including literary and linguistic scholarship. IdeaList, a free-text database manager, is popular among historians; Access and other database packages are also widely used. Additional programs, including Collate and Concorder, have emerged from the innovations of individual scholars. An ongoing critical appraisal of software would be of significant value to humanist scholars; the number of available packages and diversity of application areas make this task well beyond the scope of this publication.

Many historical applications demand the power of relational databases to handle the complex interrelation of the data. A recognized standard language for such databases, the Structured Query Language (SQL), is used in such management systems as INGRES and Oracle. Numerical analysis was one of the first applications of computers in historical and archaeological research; the Statistical Package for the Social Sciences (SPSS) continues to be widely used and is well supported by computing services, with microcomputer versions now also available. A wide variety of modelling and graphical packages are also in use, some of which, such as ARC Info, integrate advanced mapping with relational database facilities. Commercial software, even when it can be customized, does not meet all the needs of scholars and in some cases it is important to write special software for humanities applications.

The exchange of textual information poses problems, some of which can be alleviated by the use of standard conventions. Many electronic texts are now encoded using Standard Generalized Markup Language, which is the International Standards Organisation convention for the description of electronic documents. Before this standard was accepted, electronic texts were often encoded

using idiosyncratic systems, which meant that they could not be exchanged among scholars. The pace of conversion of text to electronic form has accelerated rapidly, and the Text Encoding Initiative was established in order to address the problem of a proliferation of differently encoded texts (McCarty). The objective of this international project is to develop guidelines for the preparation and interchange of machine-readable texts for scholarly research. The first guidelines, produced in 1990, suggested that SGML be adopted by scholars for the encoding of electronic text. SGML provides a syntactic framework within which markup or encoding tags can be defined by adding only those characters which can be transmitted over networks and read by most computers. The application of SGML is not limited to textual resources and can be extended to other disciplines; for instance, it is already in use for the encoding of music. If these standards gain general acceptance, the encoding of new data and the interchange of existing data will be positively revolutionized. Encoded Archival Description (EAD) is being developed to work in tandem with SGML. Unicode, a platform-independent scheme for languages using non-Latin characters (including Greek, Russian, Arabic, Hebrew, Japanese, Korean, and Chinese), is also under development as an international standard to enhance access to computerized information.

SGML has sparked the creation of a new generation of text-handling software. Dynatext, which makes use of SGML to provide sophisticated textual analysis and manipulation, is typical of these recent products: it accepts SGML-encoded text directly and creates electronic texts, automatically building a full-text index and establishing hypertext links for tables, figures, footnotes, and cross-references. A browsing facility allows users to read, query, and annotate the text; full-text searching is also supported. Style sheets use SGML tagging to define the format for on-screen display or printed document. This system is not without its limitations; chief among them, for humanists, is cost. Many of the most powerful and advantageous software tools are priced far beyond the means of most scholars, even when generous educational discounts are provided. Panorama, a Web browser for SGML-encoded texts, provides the same functionality as Dynatext for documents published over the Internet.

Researchers use text-handling software to carry out complex analyses that would be tedious and time-consuming if attempted manually. Many such packages are now available to scholars; one of the best known is the Oxford Concordance Program (OCP), originally developed for mainframe computers but now available in a PC version. OCP is a general- purpose tool suitable for such applications as stylistic analysis, preparation of language courses, vocabulary acquisition, dictionary making, text editing, and content analysis. It is widely used in literary research and in other disciplines (history, for example) where textual analysis is required.

Investigation of manuscript traditions and the creation of critical editions from multiple sources requires specialized software. Collate, a program developed by the Computers and Manuscripts project at the Oxford University Computing Services, helps scholars collate up to a hundred texts simultaneously; it provides facilities for adjustments of the collation by the user and can generate output in many different formats, including several recommended by the Text Encoding Initiative.

A number of simple-to-use hypertext authoring systems are now available, such as HyperCard from Apple. Instructors can use these programs to compile their own hypertext courseware. Authoring tools which offer a "shell" for the production of multimedia materials are also widely used: these include Macromedia, Storyspace (Eastgate), and Toolbook (Asymetrix).

Summary and Outlook

This synopsis indicates that much research is underway involving the creation of new resources, the conversion of conventional sources into machine-readable form, and the analysis of material to answer scholarly questions. Computers serve different functions at different stages in the process of research. The current model of raw materials of scholarship includes text, data, sound, and images, but there has been a growing attempt by humanists to use computers to model knowledge. Expert systems are being used by some researchers along with other Artificial Intelligence techniques (neural networks, for example) to formalize knowledge and automate the process of interpretation. While projects in this area have generated lively debate, few have produced useful results to date. However, they do show promise and are likely to become increasingly important in the coming decade.

III. New Developments and Change

Some critics of computing in the humanities emphasize the misplaced optimism of enthusiasts and the dangers inherent in an uncritical approach. Many have expressed fear that resources will be diverted from more conventional scholarship, and that research will be undertaken not for its intellectual value, but because it lends itself to the use of computers. Not all forms of research will benefit equally from new technology, and some are likely to benefit only through word processing and access to networked bibliographies. Nevertheless, the academic acceptability of computer-based research has grown steadily over the years. Much important scholarship has resulted from the use of computers; for example, the seminal study by J. F. Burrows showing how Jane Austen built up distinctive idiolects to establish and even accentuate the individual characters in her novels.

Less widely acknowledged is the intellectual effort required to design and create sets of machine-readable data. In historical research, for example, the data extracted from archival material must be collected, structured, and captured before it can be analyzed; transformation of the source material into a database requires deep understanding of its structure and nature and in and of itself constitutes a major intellectual achievement. Good examples include the electronic version of the Berkeley Finding Aids and the Dumbarton Oaks Hagiography Database. Furthermore, the design of teaching tools poses major conceptual problems, requiring attention both to scholarly and pedagogical content as well as form of presentation and likely psychological impact.

Innovative tools and resources encourage new kinds of research. Scholars can obtain numerous benefits from study of the ARTFL or Linguistic Data Consortium databases; answers to questions that could take months to answer using the print sources can be provided in seconds. Computer graphics techniques are having a profound effect on the ways archaeologists represent and analyze the data they record. Computer graphics will eventually transform every field of archaeological inquiry, from survey, excavation, and analysis to reconstruction, synthesis, and communication.

Until recently, it has been difficult to find many examples of scholarly research that could not have been achieved *without* a computer. This is changing, as the work of Baker and Ledger make evident. Humanities computing has been focused on the production of scholarly resources; interest is now shifting towards the use of these resources and the types of scholarship that can be undertaken with them. Computers cannot compensate for poor training, limited knowledge, and weak critical judgement; they are best seen as a researcher's assistant. It is in this way that new technology is having a profound effect on both research and teaching.

With the impact of new technology, the traditional image of the humanities scholar is changing. The Internet gives scholars access to bibliographies, discussion lists, electronic journals, and bulletin boards across North America and the world, thus fostering the development of a genuinely international community of scholars in the humanities. Recent years have seen the emergence of a new style of team-based research in the humanities, in part the result of these developments. If this trend continues, it will require new thinking on the part of institutions and funding agencies.

A common interest in the use of computers is drawing scholars together across the boundaries between disciplines and subdisciplines in the humanities. Scientists and humanists enjoy an increasing understanding of each other's methods and preoccupations. This trend has also served

to make interdisciplinary work easier, as can be seen in the collaboration of scientists and engineers with archaeologists and musicologists.

The use of computers also may change the way humanists think about and organize their research. Computers facilitate formerly time-consuming tasks; improved access to data at remote sites and the ability to manipulate these data swiftly offer the scholar the opportunity to become more of a thinker than a searcher. Computers opened up new and unanticipated areas for investigation which demand new ways of thinking; they make explicit what in the past has been done intuitively; the preparation of data in a logical, formalized manner is an intellectually informative task and can reveal types of evidence and questions that would not otherwise have emerged. At the same time, systems are being developed which are particularly suited to the way humanists have always thought and worked: hypermedia and hypertext provide an enhanced form of the browsing and cross-referencing facilities traditionally demanded by researchers.

This may be one reason why hypermedia authoring tools are widely used in the creation of courseware. The use of such systems in teaching is beginning to blur the distinction between teaching and research, which will become progressively less clear-cut as students explore source material held in electronic form previously available only to their instructors. Indeed, computers tend to encourage a redefinition of teaching itself and to shift the emphasis towards the learning part of the process.

IV. To Challenge and Invigorate Future Scholarship

Introduction

The preceding overview of computer-based humanities projects may give the impression that computer-based research in the humanities is thriving. However, many of these projects are run on shoestring budgets. If the initiatives described in Section II are to become the norm in the humanities, then action must be undertaken to overcome a number of barriers: institutional, organizational, material, and personal. Information technology involves not only the provision of skills and equipment, but also changes in attitudes and working practices. Dramatic growth in funding, distribution of resources to assure broad coverage, and encouragement of an information-rich scholarly community are all essential.

Training and Support

Adequate training and support services are key to the successful implementation of new technology. Lack of understanding of available resources and shortcomings in the skills to exploit them are major factors preventing effective use of information among researchers, teachers, and students in the humanities. Some institutions have been unable to network their campus buildings, and many humanists still have considerable difficulties in gaining access to even the most basic computing resources.

Project Management

Traditional humanities scholarship relies largely on the work of an individual scholar, while successful projects in humanities computing often involve the collaborative efforts of scholars, librarians, and technologists from different fields and institutions, along with the support of national funding organizations. The future of humanities scholarship lies in such large-scale collaborative projects, which can draw on expertise from a variety of sources.

Furthermore, projects focusing on primary sources or scholarship in electronic formats are increasingly attractive to academic publishing houses. The University of Michigan Press actively seeks electronic publishing projects, while Johns Hopkins University Press delivers electronic versions of many print publications. This growing interest points to future projects between the university press and humanities departments, units that have traditionally had limited contact at most campuses.

Research Infrastructure

In articulating their needs on a national level, humanities scholars are hindered by the absence of a national agency for coordinating humanities technology, which has implications for both funding and promotion of research and research requirements. Cultural change within the humanities themselves is clearly needed. Electronic and network publication has not taken off in the humanities

for a variety of complex reasons: problems with refereeing, lack of standards governing the citation of electronic publications, the ostensibly ephemeral nature of electronic documents, difficulty of access, and lack of consensus on what constitutes a publication and what it means to be published. Electronic journals have generally not achieved the academic credibility of their printed counterparts. On the other hand, it is already apparent that the barriers to acceptance of the CD-ROM medium of publication have begun to break down.

Digital Libraries and Archives

An important phenomenon of the electronic age is the building of large-scale digital libraries and archives. This activity received a major incentive when the National Science Foundation (NSF), the Department of Commerce, and NASA announced a multi-million dollar program to fund competitive proposals for the creation of digital libraries of national significance. Participating institutions include the University of Michigan, working with Bedford Stuyvesant High School in Brooklyn and other libraries focusing on issues of information retrieval and usage in the earth sciences; the University of Illinois at Urbana-Campaign, exploring applications of science and engineering journal articles; the University of California at Santa Barbara, whose Alexandria Digital Library project focuses in large part on graphical information such as maps; the University of California at Berkeley's Digital Library Project, investigating the fundamental transformations in traditional concepts of the library; and Stanford's Integrated Digital Library, exploring ways to link a vast array of information, from personal data to large-scale information services employing meta-system retrieval software.

The Library of Congress recently teamed with about a dozen of the largest research universities in the United States to form the Digital Library Federation, a consortium that will explore the technical and methodological aspects of constructing a digital library of owned resources. A national digital library of sufficient size, scope, and complexity would support a meaningful test of the effect of distributed digital libraries on equitable access, learning and scholarship, and the economics and organization of libraries.

At the same time, large-scale archival projects are coming to the fore. These include Harvard's Israeli Posters project, which will eventually digitize over 70,000 religious posters in its collections; the Huntington Library's William Blake Works; Project Utopia at Cornell, which aims to digitize 150,000 images of Renaissance art and architecture; and the recently announced plans by the National Archives and Records Administration (NARA) in Washington, D.C. for converting its archival holdings to digital format, making these materials accessible over the Internet for the first time.

Information Resources

Humanists depend to a very considerable extent on libraries in their own and remote institutions, and on a network of museums, galleries, and archives. Much evidence suggests that library resources are diminishing as a result of shrinking budgets; rising numbers and costs of traditional publications; the need to conserve books from the nineteenth and early twentieth centuries; the introduction of automated catalogs; and the need to purchase new electronic resources and the equipment to make them accessible to library users. At the same time, the growth of new ways of accessing information, from Online Public Access Catalogues (OPACs) to CD-ROMs and Internet search engines, has raised

users' expectations, with the result that research libraries now find it difficult to strike a balance between expenditures on traditional and novel forms of providing information.

A review of libraries conducted by the Andrew W. Mellon Foundation (Cummings et al.) examined the changing budget structures at universities. It concluded that libraries were continually losing ground as a percentage of expenditure by educational institutions, thereby exacerbating problems created by increasing costs of journals and exchange rate fluctuations. As noted earlier, Project Muse is a possible future application to address this problem, as is JSTOR, a large-scale project funded by the Mellon Foundation to digitize science serials for greater accessibility and preservation.

The growing number of projects creating electronic resources and the increase in demand for electronic information highlight the fact that no agency has taken an active role in fostering the growth of a national electronic archive for the humanities, analogous to the ESRC Data Archive for the Social Sciences. A national strategy is required for the holding, maintenance, and provision of access to such material. Funding is needed, as well, to secure the conversion of information into electronic form. Since many sources are of national and international significance, attempts should be made to support collaborative efforts to create electronic information sources and tools.

Regulatory Issues

The field of information technology is subject to rapid change. In the rush to exploit new ways of creating and accessing information, regulatory issues are often neglected or brushed aside. A case in point is the variety of coding systems devised by individual scholars for textual analysis of electronic texts, described earlier in this report. Standardization is always several steps behind innovation, but remains essential for information technology to yield real benefits. Cooperation is hindered by a lack of common standards. The Open Systems Interconnection (OSI) and similar systems, are, of course, relevant, but there are other areas more closely associated with humanities computing where humanists can have a direct influence. An example is SGML, described earlier; its acceptance will transform electronic texts and electronic publishing in general. The great changes underway in humanities information justify standards like SGML, which are extensible and have application across disciplines and data types.

Intellectual property and copyright are additional areas of concern. The advent of electronic information systems has created a host of problems not addressed by the 1976 Copyright Act. These demand urgent consideration if they are not to hinder the development of electronic publications and information resources. Two fundamental themes involve the determination of fair compensation based on ownership of object by the creator, and the issue of what constitutes fair use. Encryption, image fingerprinting, and other security measures have arisen from these concerns.

Preservation and Access

Research libraries have traditionally seen to the preservation of fragile books and rare materials. These activities are highly dependent on cooperation among institutions, and libraries have historically worked together to develop methodologies and standards for producing microfilm, which is the preferred preservation medium. A library participating in the Research Libraries

Information Network (RLIN), for example, has access to established procedures and mechanisms for signalling to the rest of the library community that it will take responsibility for the preservation of a particular item through microfilming. Other research libraries need not duplicate the effort and can use the product of the preservation work undertaken by the first institution. In addition, libraries with particular strengths have often worked together to preserve all materials in a particular field or subfield.

Digital technology is emerging as an effective and affordable preservation and access tool. In addition, libraries can add value to their collections by providing scholars with digital facsimiles of library materials supplemented by rich background and contextual information as well as text and image manipulation tools to which they might not otherwise have access. The Griffis Collection and the Early American Fiction Archive exemplify a new approach to preservation that not only captures some of the physical qualities of a text, but also provides additional means of access to the texts, via searchable textbases or archival finding aids.

Funding

Inevitably, many of our observations are concerned with funding. Additional resources are necessary for the humanities to play an expanded role in higher education and to continue to produce scholarly research. At the same time, scholars in the humanities can achieve much themselves, both individually and collectively, by making their needs known to those responsible for policy and funding at the institutional and national levels.

Both the National Endowment for the Humanities and the National Endowment for the Arts have seen their funding sharply reduced over the past two years. Humanists will therefore need to turn to private foundations—the Andrew W. Mellon Foundation, the Pew Charitable Trusts, the John Simon Guggenheim Memorial Foundation, and the Ford, Wilson, Spencer, and Rockefeller Foundations—for support of projects that employ technology.

Still, the nation must confront an important public policy issue: How will the cultural heritage of the United States find its way into digital, networked form? How will this heritage become available, and in what forms, for education, for support of a democratic ethos, and for other civic purposes? Should public funding play a role in this process?

Humanities Support Services

Several research universities have established support units specifically for humanities computing endeavors. The Institute for Advanced Technology in the Humanities was established at the University of Virginia in 1992, with a major grant from IBM and a multi-year commitment of support from the university. The Center for Electronic Texts in the Humanities, founded in 1991 as a joint project of Rutgers and Princeton Universities, has received substantial support from the National Endowment for the Humanities (NEH) and the Andrew W. Mellon Foundation. The Center serves as a clearinghouse for information about computer-based research in the humanities and sponsors several projects for developing access to electronic texts. The University of Michigan sponsors a Collaboratory for the Humanities; several scholars are given a computer workspace at the Humanities

Text Initiative where they create multimedia projects for research on teaching with computing consultants.

These services bring together staff with expertise in computing languages, textual encoding, digital imaging, organization, and access issues to facilitate the development of humanities electronic scholarship and publishing. Support, however, is often limited to scholars on their home campuses. Since many colleges and universities do not sponsor humanities computing services, their faculties may suffer a disadvantage which will ultimately have an impact on humanities scholarship as a whole.

V. Principal Recommendations and Follow-up Activities

Action is required on many fronts if the potential advances in research described in this brief survey are to become the norm throughout the humanities. This will depend in part on action by scholars in the humanities, for surveys have revealed a culture of low expectations in terms of funding for equipment, maintenance, and support and a consequent under-representation on university computing and equipment committees. Although this situation is beginning to change with the growing awareness of the benefits of information technology, humanities scholars must make their needs explicit and press for representation. Unfortunately, this change is taking place at a time of acute pressure on funding in higher education in general, and hence shortages even among established users of information technology.

Those responsible for the allocation of funds must ensure that support for information technology in the humanities matches that expected in science and social science faculties, and that the true costs of using such technology are recognized. Similarly, scholars in the humanities must have opportunities to develop skills in the application of information technology, especially those with little experience in the field.

A national strategy is needed for the conversion of analogue material into digital form, for the holding of research material that will maintain comprehensive coverage, and for the provision of user-friendly systems to ensure that such material will be made available over the Internet. The use of information in electronic form also requires attention to copyright issues and to the development and promotion of standards for the documentation and transfer of material in electronic form.

This report will be most useful if, in conclusion, it recapitulates some of the priorities articulated at a number of meetings of humanists, technical experts, librarians, and administrators over the last five years. These priorities include:

- establishing an annual review of arts and humanities computing, whether a conference or electronic list, where progress can be reported and assessed.
- greater support for standardization requirements and computing needs in the humanities and arts, in the context of ongoing corporate and industrial discussions.
- the promotion by scholars, administrators, and librarians of the institutional and social change required for the creation of a hospitable environment for computer-supported arts and humanities.
- progress by humanists in the coming decade in developing shared methods of knowledge representation.
- the creation of a significant mass of digitized networked information in the humanities and arts that can enrich a sense of community, foster intellectual collaboration, preserve cultural information, and improve the quality of teaching and learning.

Added to these are the more technical issues of ensuring the highest fidelity of representation of original works; the preservation of integrity over time of digital information; and the promotion of detailed description and commentary of objects and documents to assure accurate provenance and future access.

VI. Appendices

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Eastgate Systems, Inc.
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Eighteenth-Century Short Title Catalogue
http://portico.bl.uk:7011/1/portico/resource/hss/early/estc1.txt
British Library
Great Russell Street
London WC1B 3DG, England

Electronic Archive of Early American Fiction
http://etext.lib.virginia.edu/eaf/
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University of Virginia
Special Collections Department
Alderman Library
Charlottesville, VA 22903-2498

Electronic Beowulf
http://www.uky.edu/~kiernan/BL/kportico.html
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Manuscript Collections
British Library
Great Russell Street
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Electronic Text Library
http://etext.lib.virginia.edu/etext/ETC.html
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Electronic Poetry Center,
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ESRC Data Archive
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Ethnologue: Languages of the World
http://www.sil.org/ethnologue/
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Griffis Archive
http://www.ceth.rutgers.edu/projects/griffis/project.htm
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Hartlib Papers Project
E-mail: HARTLIB@UK.AC.SHEFFIELD.PRIMEA
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History Reviews Online
http://www.uc.edu/www/history/reviews.htmlx
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HUMANIST
http://www.princeton.edu/~mccarty/humanist
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Humanities Advanced Technology & Information Institute
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Humanities Text Initiative
http://www.hti.umich.edu/
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http://info.ox.ac.uk/departments/humanities/international.html
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International Philosophical Preprint Exchange,
http://www.L.chiba-u.ac.jp/IPPE.html
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Internet Archaeology
http://intarch.ac.uk
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Inventory of the Scottish Church Heritage
Council for Scottish Archaeology, Churches Committee
c/o Royal Commission on Ancient and Historical Monuments of Scotland
John Sinclair House
16 Bernard Terrace
Edinburgh EH8 9NX, Scotland.

Institute for Advanced Technology in the Humanities
http://jefferson.village.virginia.edu/
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Journal of Buddhist Ethics
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http://www.sscm.harvard.edu/jscm/welcome.html
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JSTOR
http://www.jstor.org
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Labyrinth
http://www.georgetown.edu/labyrinth/labyrinth-.home.html
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Language Visualization and Multilayer Text Analysis
http://www.tc.cornell.edu/~tonyg/Language3D/Language.Viz1.html
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Linguistic Data Consortium,
http://www.ldc.upenn.edu/
3615 Market Street, Suite 200
Philadelphia, PA 19104-2608

LION: Literature Online
http://www.chadwyck.com/lion/
Chadwyk-Healey, Inc.
1101 King Street
Alexandria, VA 22314

Literary Resources on the Net
http://www.english.upenn.edu/~jlynch/Lit/
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Mapping London in the 1690s
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Machine-Readable Spoken English Corpus
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Making of America Project
http://library.cit.cornell.edu/MOA/moa-main_page.html
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Mississippi Review
http://sushi.st.usm.edu/mrw/
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Museum Educational Site Licensing Project
http://www.ahip.getty.edu/mesl/home.html
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Getty Information Institute
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Santa Monica, CA 90401-1455

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Royal Holloway and Bedford New College
University of London
Music Studies
Egham Hill
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Adam Matthew Publications
8 Oxford Street
Marlborough, Wilts SN8 1AP, England

NISS
E-mail: NISS@SWURCC
Bath University Computing Services
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Claverton Down
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Online Computer Library Center, Inc. (OCLC)
http://www.oclc.org/
6565 Frantz Road,
Dublin, OH 43017-3395

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http://www-oi.uchicago.edu/OI/MUS/QTVR96/QTVR96_Text_Menu.html
John C. Sanders
University of Chicago
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Chicago, IL 60637

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Janet Caldwell
Oxford University Press
Electronic Publishing
Walton Street
Oxford OX2 6DP, England

Oxford Text Archive
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Perseus
http://www.perseus.tufts.edu/
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Postmodern Culture and PMC-MOO
http://jefferson.village.virginia.edu/pmc/contents.all.html
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Raleigh, NC 27695-8105

Project Muse
http://muse.jhu.edu/
Johns Hopkins University Press
2715 North Charles Street
Baltimore, MD 21218-4319

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http://www.library.yale.edu/preservation/pobweb.htm
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Prosopography of the Byzantine Empire
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REESWeb: Russian and East European Studies Internet Resources
http://www.pitt.edu/~cjp/rees.html
University of Pittsburg
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4G-15 Forbes Quadrangle
Pittsburgh, PA 15260

Research Libraries Information Network
http://www.rlg.org/
Research Libraries Group
1200 Villa Street
Mountain View, CA 94041-1100

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http://jefferson.village.virginia.edu/~dfa4y/dgr/

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SGML Web Page
http://sil.org/sgml/

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Slavic Review,
http://ccat.sas.upenn.edu/slavrev/slavrev.html

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639 Williams Hall
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SPIRO: Architecture Image Database
http://www.mip.berkeley.edu/query_forms/browse_spiro_form.html

Maryly Snow
University of California, Berkeley
Architecture Slide Library
Department of Architecture
College of Environmental Design
315 Wurster Hall
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Stanford Encyclopedia of Philosophy
http://plato.stanford.edu/

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STELLA
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Thesaurus Linguae Graecae
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TORGO: WebTool for On-Line Journal Research
http://humanitas.ucsb.edu/torgo.html
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Trans-Atlantic Slave Trade Database,
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Henry Louis Gates, Jr.
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http://jefferson.village.virginia.edu/vshadow2/contents.html
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Victorian Web
http://www.stg.brown.edu/projects/hypertext/landow/victorian/victov.html

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Victorian Women Writers Project
http://www.indiana.edu/~letrs/vwwp/index.html
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Library Electronic Text Service
Main Library E-157
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Voice of the Shuttle
http://humanitas.ucsb.edu
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VRoma
http://hippokrene.colleges.org/~vroma/
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Wesleyan Confucian Project
http://www.wesleyan.edu/~sangle/etext/index.html
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Winchester Graphics System and The 'WIMSOM' Solid Modeller
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Women Writers Project
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Abbreviations and Acronyms

AALN	American Arts and Letters Network
ACH	Association of Computers and the Humanities
ACLS	American Council of Learned Societies
AHDS	Arts and Humanities Data Service
AI	Artificial Intelligence
ALLC	Association of Literary and Linguistic Computing
ARL	Association of Research Libraries
ARPA	Advanced Research Projects Agency
ARTFL	American and French Research on the Treasury of the French Language
CBA	Council for British Archaeology
CDP	Composer's Desktop Project
CD-ROM	Compact Disc—Read Only Memory
CETH	Center for Electonic Texts in the Humanities
CHEST	Combined Higher Education Software Team
CNI	Coalition for Networked Information
CREATE	Center for Research in Electronic Art Technology
DIAP	RLG's Digital Image Access Project
DLF	Digital Library Federation
DOE	Dictionary of Old English
DORA	Divided Object Ray-trace Algorithm
EAD	Encoded Archival Transcription
E-mail	Electronic mail
ESRC	Economic and Social Research Council
FTP	File Transfer Protocol
GII	Getty Information Institute
GPO	General Printing Office
HRC	Humanities Research Council
HTI	Humanities Text Initiative
GIS	Geographical Information System
IATH	Institute for Advanced Technology in the Humanities
ICE	International Corpus of Spoken English
ICECUP	International Corpus of Spoken English Corpus Utility Program
ICPSR	Inter-university Consortium for Political and Social Research
IP	Internet Protocol
IRC	Internet Relay Chat
IRCAM	Institut de Recherche et Coordination Acoustique/Musique
ISC	Information Systems Committee
ISDN	Integrated Services Digital Network
ISI	Institute of Scientific Information
ISO	International Standards Organisation
IT	Information Technology

IUE	Image Understanding Environment
JANET	Joint Academic Network
JISC	Joint Information Services Committee
LASE	Limited Area Search Engine
MARSEC	Machine-Readable Spoken English Corpus
MESL	Museum Educational Site Licensing project
MIDI	Musical Instrument Digital Interface
MIT	Massachusetts Institute of Technology
MLA	Modern Language Association
MOO	Multi-User Dimension Oriented Object
MUD	Multi-User Dimension
NAR	National Archaeological Record
NARA	National Archives and Records Administration
NEA	National Endowment for the Arts
NEH	National Endowment for the Humanities
NINCH	National Inititiative for a Networked Cultural Heritage
NISS	National Information on Software and Services
NMR	National Monuments Record
NSF	National Science Foundation
OCLC	Online Consortium of Library Catalogs
OCP	Oxford Concordance Program
OCR	Optical Character Recognition
OED	Oxford English Dictionary
OPAC	Online Public Access Catalogue
OSI	Open Systems Interconnection
OUCS	Oxford University Computing Services
OUP	Oxford University Press
PC	Personal Computer
RILA	International Repertory of the Literature of Art
RLG	Research Libraries Group
RLIN	Research Libraries Group Information Network
RRAG	Research Resources Advisory Group
SGML	Standard Generalised Markup Language
SPSS	Statistical Package for the Social Sciences
SQL	Structured Query Language
TEI	Text Encoding Initiative
TLG	Thesaurus Linguae Graecae
TLTP	Teaching and Learning Technology Programme
ULAN	Union List of Artists' Names
VASARI	Visual Arts System for Archival and Retrieval of Images
VRML	Virtual Reality Modeling Language
WGS	Winchester Graphics System

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